



RAR PPPoE IPv6 Multicast

From Cisco IOS XE 17.11.1a, IPv6 multicast configuration is available for PPPoE-based RAR sessions.

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Prerequisites

For IPv6 multicast over PPPoE to function properly, the following must be configured:

- PPPoE (Virtual-template, VMI and physical interface)
- IPv6 unicast and multicast routing
- IPv6 PIM BSR
- IPv6 MLD

Configuring VMI interface and Enabling Multicast Support

Used in router-to-radio communications, the Virtual Multipoint Interface (VMI) interface provides services that map outgoing packets to the appropriate Point-to-Point Protocol over Ethernet (PPPoE) sessions based on the next-hop forwarding address for that packet. The VMI interface also provides a broadcast service that emulates a set of point-to-point connections as a point-to-multipoint interface with broadcast ability. When a packet with a multicast address is forwarded through the VMI interface, VMI replicates the packet and unicasts it to each of its neighbors.



Note

VMI will map outgoing packets to the appropriate PPPoE sessions. It will use the next-hop forwarding address from each outgoing packet to perform this mapping.



Note VMI is required to have IP addresses assigned for VMI to work even though it will be shown as down/down while in bypass mode. The IPv4 address configured will not be advertised or used. Instead, the IPv4 address on the virtual-template will be used.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 2	interface vmi <i>number</i> Example: Router(config)# interface vmi 1	Creates a VMI and enters interface configuration mode.
Step 3	ipv6 enable Example: Router(config-if)# ipv6 enable	Enable IPv6 support under VMI interface. OSPFv3 IPv4 needs to have IPv6 support enabled on the interface level.
Step 4	ip address <i>address mask</i> Example: Router(config-if)# ip address 71.0.0.1 255.255.255.0	Configures IPv4 address under VMI interface.
Step 5	ipv6 address <i>address/prefix</i> Example: Router(config-if)# ipv6 address 71::71/64	Configures IPv6 address under VMI interface.
Step 6	physical-interface <i>interface</i> Example: Router(config-if)# physical-interface gigabitEthernet {0/0/0 or 0/0/1 or 0/0/0.1}	Binds the physical interface (the interface connected to the radio client) to the VMI interface, for packet flow.
Step 7	mode <i>name</i> Example: Router(config-if)# mode bypass	Do not aggregate Virtual Access Interfaces under VMI. (Must be configured as bypass).

Configuring IPv6 PIM Bootstrap Router (BSR)

The bootstrap router (BSR) protocol for PIM-SM provides a dynamic, adaptive mechanism to distribute group-to-RP mapping information rapidly throughout a domain. With the IPv6 BSR feature, if an RP becomes

unreachable, it will be detected and the mapping tables will be modified so that the unreachable RP is no longer used, and the new tables will be rapidly distributed throughout the domain.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 2	ipv6 pim bsr candidate bsr loopback_ipv6_address Example: Router(config)# ipv6 pim bsr candidate bsr 11::11	Configures a device to be a candidate BSR. Note Must use the loopback ipv6 address configured earlier.
Step 3	ipv6 pim bsr candidate rp loopback_ipv6_address Example: Router(config-router)# ipv6 pim bsr candidate rp 11::11	Configures a device to be a candidate Rendezvous Point (RP). Note Must use the loopback ipv6 address configured earlier.

Configuring IPv6 Multicast Group

An IPv6 multicast group is an arbitrary group of receivers that want to receive a particular data stream. This group has no physical or geographical boundaries--receivers can be located anywhere on the Internet or in any private network.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 2	interface interface_name Example: Router# interface Vlan 10	Creates and enters interface configuration mode.
Step 3	ipv6 mld join-group multicast_group_address Example: Router(config-if)# ipv6 mld join-group FF06:6::1	Configure IPv6 mld join group under interface.

Verifying BSR Election

This section shows examples of command output to verify your setup.

```
Router-1#show ipv6 pim bsr election
PIMv2 BSR information

BSR Election Information
  Scope Range List: ff00::/8
  This system is the Bootstrap Router (BSR)
    BSR Address: 61::61
    Uptime: 00:05:20, BSR Priority: 0, Hash mask length: 126
    RPF: FE80::7E31:EFF:FE85:1E78,Loopback0
    BS Timer: 00:00:41
  This system is candidate BSR
    Candidate BSR address: 61::61, priority: 0, hash mask length: 126
Router-1#

Router-2#show ipv6 pim bsr election
PIMv2 BSR information

BSR Election Information
  Scope Range List: ff00::/8
    BSR Address: 61::61
    Uptime: 00:01:22, BSR Priority: 0, Hash mask length: 126
    RPF: FE80::7E31:EFF:FE85:1E78,Virtual-Access1.1
    BS Timer: 00:01:47
  This system is candidate BSR
    Candidate BSR address: 41::41, priority: 0, hash mask length: 126
Router-2#
```

Verifying IPv6 Multicast Configuration

This section shows examples of IPv6 multicast configuration.



Note “*” in the source address indicates MLD join request entry.

```
Router-1#show ipv6 mroute
Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group,
       C - Connected, L - Local, I - Received Source Specific Host Report,
       P - Pruned, R - RP-bit set, F - Register flag, T - SPT-bit set,
       J - Join SPT, Y - Joined MDT-data group,
       y - Sending to MDT-data group
       g - BGP signal originated, G - BGP Signal received,
       N - BGP Shared-Tree Prune received, n - BGP C-Mroute suppressed,
       q - BGP Src-Active originated, Q - BGP Src-Active received
       E - Extranet
Timers: Uptime/Expires
Interface state: Interface, State

(A000::2, FF06:6::1), 00:01:45/00:01:44, flags: SFT
Incoming interface: Vlan30
RPF nbr: A000::2
```

```

Immediate Outgoing interface list:
  Virtual-Access1.1, Forward, 00:01:45/00:02:48

Router-1#
Router-2# show ipv6 mroute
Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group,
       C - Connected, L - Local, I - Received Source Specific Host Report,
       P - Pruned, R - RP-bit set, F - Register flag, T - SPT-bit set,
       J - Join SPT, Y - Joined MDT-data group,
       y - Sending to MDT-data group
       g - BGP signal originated, G - BGP Signal received,
       N - BGP Shared-Tree Prune received, n - BGP C-Mroute suppressed,
       q - BGP Src-Active originated, Q - BGP Src-Active received
       E - Extranet
Timers: Uptime/Expires
Interface state: Interface, State

(*, FF06:6::1), 00:04:33/00:03:29, RP 41::41, flags: SCL
  Incoming interface: Tunnel2
  RPF nbr: 41::41
  Immediate Outgoing interface list:
    Vlan30, Forward, 00:04:33/00:03:29

(A000::2, FF06:6::1), 00:01:41/00:02:43, flags: ST
  Incoming interface: Virtual-Access1.1
  RPF nbr: FE80::7E31:EFF:FE85:1E78
  Immediate Outgoing interface list:
    Vlan30, Forward, 00:01:41/00:02:49
Router-2

```

Sample Running Configuration

The following output shows a sample configuration for IPv6 multicast over RAR PPPoE.

```

Router-1#show run
Building configuration...

Current configuration : 7911 bytes
!
! Last configuration change at 13:04:28 UTC Wed Jun 8 2022
!
version 17.9
service timestamps debug datetime msec
service timestamps log datetime msec
service call-home
platform qfp utilization monitor load 80
platform hardware throughput level 250M
platform punt-keepalive disable-kernel-core
!
hostname Router-1
!
boot-start-marker
boot system flash bootflash:c6300-universalk9.17.09.01.SSA.bin
boot-end-marker
!
!
no logging console
no aaa new-model
!

```

Sample Running Configuration

```

!
login on-success log
ipv6 unicast-routing
ipv6 multicast-routing
!
!
subscriber templating
subscriber authorization enable
!
!
multilink bundle-name authenticated
!
!
crypto pki trustpoint TP-self-signed-4073554590
  enrollment selfsigned
  subject-name cn=IOS-Self-Signed-Certificate-4073554590
  revocation-check none
  rsakeypair TP-self-signed-4073554590
!
crypto pki trustpoint SLA-TrustPoint
  enrollment pkcs12
  revocation-check crl
!
!
crypto pki certificate chain TP-self-signed-4073554590
  certificate self-signed 01
    30820330 30820218 A0030201 02020101 300D0609 2A864886 F70D0101 05050030
    31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
    69666963 6174652D 34303733 35353435 3930301E 170D3232 30363038 31313137
    31345A17 0D333230 36303731 31313731 345A3031 312F302D 06035504 03132649
    4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D34 30373335
    35343539 30308201 22300D06 092A8648 86F70D01 01010500 0382010F 00308201
    0A028201 0100C54E 860F73AC F0A9EBC7 2C6D1204 49099324 85989550 32CA9B91
    3B3A2492 AEA1D550 OCD787DE 09F6B64F 3F01C578 3EFB3995 E448904A 957EAFD9
    B82EF201 3A28BE26 6B1615DA 35B35BEA D4B7B20F 2D2A3EC2 C1F52281 349E88E5
    F2BCBA37 CA72D461 97D1E817 7493ED38 7C7C1035 F7231D4E F59FADF9 EE0EE5EE
    1FD73691 E93EBE8C 262DC8B1 0FA25BF0 C2F65BF9 C57A406A 9F9CF3D3 3E6888C3
    D6B533AB 0DA71037 6C94A385 CECA4DD9 A037C344 5B761E6D F3B8D47B 4093BED8
    E497D649 63436773 7BE5A718 331C7F08 31071542 03AE588C 08605CF7 CC7C7D6F
    967759FC E2A943FF 8AD70094 825AAD4B DC66FEC8 5B7F2CDA 24F148E1 51AF106E
    FE212C21 651B0203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF
    301F0603 551D2304 18301680 14F49EA0 C5E78BB1 F0EA55AD 4C580FB7 BF1AE35C
    50301D06 03551D0E 04160414 F49EA0C5 E78BB1F0 EA55AD4C 580FB7BF 1AE35C50
    300D0609 2A864886 F70D0101 05050003 82010100 2083EBC1 E760806B 12F0ACEF
    8FDE2E11 E5B88B62 B85B5835 AB1D2471 EA6FCC2D B28F5EE2 1969C233 DBB8C435
    D7BAD49C 7781E485 97D5B5D0 DD05A0EE 5352535F 1657BE78 64E6BBA8 B627618E
    49041DFB 4FE4D16C FA6857EF E6EEDFBC 2E25AF9E 852EDF71 3B65E55F 62AB1B1E
    8B842F51 DAD55DB5 8A5BF87B 91F540D2 02E8576E 5D4550EA E7FCB6D7 6AD0E92A
    EEA7544 01C4095A BB02DB3A D45D73EB 971974FF B5DED058 F2F3A0E1 23BD3441
    899CDFC2 A3B36E7D E72D4BDB 480B8347 C26D6AB9 E7E5A140 B20B7B1D 7AC24A2C
    A69124B3 49BF18AF C99EF2A5 C4F484CE 9E2A70C1 D1EA4250 6E0D858E BBCFC6C1
    4FF6E0BC EB190067 E86EC80D 5D149D6F 462CA857
  quit
crypto pki certificate chain SLA-TrustPoint
  certificate ca 01
    30820321 30820209 A0030201 02020101 300D0609 2A864886 F70D0101 0B050030
    32310E30 0C060355 040A1305 43697363 6F312030 1E060355 04031317 43697363
    6F204C69 63656E73 696E6720 526F6F74 20434130 1E170D31 33303533 30313934
    3834375A 170D3338 30353330 31393438 34375A30 32310E30 0C060355 040A1305
    43697363 6F312030 1E060355 04031317 43697363 6F204C69 63656E73 696E6720
    526F6F74 20434130 82012230 0D06092A 864886F7 0D010101 05000382 010F0030
    82010A02 82010100 A6BCBD96 131E05F7 145EA72C 2CD686E6 17222EA1 F1EFF64D
    CBB4C798 212AA147 C655D8D7 9471380D 8711441E 1AAF071A 9CAE6388 8A38E520

```

```

1C394D78 462EF239 C659F715 B98C0A59 5BBB5CBD 0CFEBEA3 700A8BF7 D8F256EE
4AA4E80D DB6FD1C9 60B1FD18 FFC69C96 6FA68957 A2617DE7 104FDC5F EA2956AC
7390A3EB 2B5436AD C847A2C5 DAB553EB 69A9A535 58E9F3E3 COBD23CF 58BD7188
68E69491 20F320E7 948E71D7 AE3BCC84 F10684C7 4BC8E00F 539BA42B 42C68BB7
C7479096 B4CB2D62 EA2F505D C7B062A4 6811D95B E8250FC4 5D5D5FB8 8F27D191
C55F0D76 61F9A4CD 3D992327 A8BB03BD 4E6D7069 7CBADF8B DF5F4368 95135E44
DFC7C6CF 04DD7FD1 02030100 01A34230 40300E06 03551D0F 0101FF04 04030201
06300F06 03551D13 0101FF04 05300301 01FF301D 0603551D 0E041604 1449DC85
4B3D31E5 1B3E6A17 606AF333 3D3B4C73 E8300D06 092A8648 86F70D01 010B0500
03820101 00507F24 D3932A66 86025D9F E838AE5C 6D4DF6B0 49631C78 240DA905
604EDCDE FF4FED2B 77FC460E CD636FDB DD44681E 3A5673AB 9093D3B1 6C9E3D8B
D98987BF E40CBD9E 1AECA0C2 2189BB5C 8FA85686 CD98B646 5575B146 8DFC66A8
467A3DF4 4D565700 6ADF0F0D CF835015 3C04FF7C 21E878AC 11BA9CD2 55A9232C
7CA7B7E6 C1AF74F6 152E99B7 B1FCF9BB E973DE7F 5BDDEB86 C71E3B49 1765308B
5FB0DA06 B92AFE7F 494E8A9E 07B85737 F3A58BE1 1A48A229 C37C1E69 39F08678
80DDCD16 D6BACECA EEBC7CF9 8428787B 35202CDC 60E4616A B623CDBD 230E3AFB
418616A9 4093E049 4D10AB75 27E86F73 932E35B5 8862FDAE 0275156F 719BB2F0
D697DF7F 28
quit
!
!
no license feature hseck9
license udi pid ESR-6300-CON-K9 sn FOC234304H3
license boot level network-advantage
memory free low-watermark processor 45135
!
diagnostic bootup level minimal
!
spanning-tree extend system-id
!
!
redundancy
mode none
!
!
vlan internal allocation policy ascending
!
policy-map type service pppoe_rar
pppoe service manet_radio
!
!
bba-group pppoe rar_group_1
virtual-template 1
service profile pppoe_rar
!
!
interface Loopback0
ip address 61.0.0.1 255.255.255.255
ipv6 address 61::61/128
ipv6 enable
ospfv3 1 ipv6 area 0
ospfv3 1 ipv4 area 0
!
interface GigabitEthernet0/0/0
media-type rj45
negotiation auto
ipv6 enable
pppoe enable group rar_group_1
!
interface GigabitEthernet0/0/1

```

```

no ip address
shutdown
negotiation auto
!
interface GigabitEthernet0/1/0
  switchport access vlan 30
!
interface GigabitEthernet0/1/1
!
interface GigabitEthernet0/1/2
!
interface GigabitEthernet0/1/3
!
interface Virtual-Template1
  mtu 1484
  ip unnumbered vmil
  no ip redirects
  ip tcp adjust-mss 1444
  load-interval 30
  no peer default ip address
  ipv6 enable
  ipv6 mtu 1484
  ospfv3 1 network manet
  ospfv3 1 hello-interval 10
  ospfv3 1 ipv4 area 0
  ospfv3 1 ipv6 area 0
!
interface Vlan1
no ip address
!
interface Vlan30
  ip address 192.168.10.1 255.255.255.0
  ipv6 address A000::1/64
  ipv6 enable
  ospfv3 1 ipv4 area 0
  ospfv3 1 ipv6 area 0
!
interface Async0/2/0
no ip address
encapsulation scada
!
interface vmil
  ip address 71.0.0.1 255.255.255.0
  ipv6 address FE80::7E31:EFF:FE85:1E78 link-local
  ipv6 address 71::71/64
  ipv6 enable
  physical-interface GigabitEthernet0/0/0
  mode bypass
!
router ospfv3 1
  router-id 101.101.101.101
!
  address-family ipv4 unicast
    redistribute connected metric 1 metric-type 1
    log-adjacency-changes
  exit-address-family

```



```

!
address-family ipv6 unicast
    redistribute connected metric-type 1
    log-adjacency-changes
exit-address-family
!
ip forward-protocol nd
ip http server
ip http authentication local
ip http secure-server
!
!
ipv6 pim bsr candidate bsr 61::61
ipv6 pim bsr candidate rp 61::61
!
!
control-plane
!
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
line con 0
    exec-timeout 0 0
    privilege level 15
    stopbits 1
line 0/0/0
line 0/2/0
line vty 0 4
    login
    transport input ssh
line vty 5 14
    login
    transport input ssh
!
call-home
    ! If contact email address in call-home is configured as sch-smart-licensing@cisco.com
    ! the email address configured in Cisco Smart License Portal will be used as contact email
    address to send SCH notifications.
    contact-email-addr sch-smart-licensing@cisco.com
    profile "CiscoTAC-1"
        active
        destination transport-method http
!
end

```

Debug Commands

This section shows debug commands for PPPoE, VMI, Virtual Template, and Subscriber Service.

PPPoE

Command or Action	Purpose
Router# debug pppoe data	PPPoE data packets
Router# debug pppoe errors	PPPoE protocol errors
Router# debug pppoe events	PPPoE protocol events
Router# debug pppoe packets	PPPoE control packets

VMI

Command or Action	Purpose
Router# debug vmi bma	Display VMI bma debug
Router# debug vmi error	Display internal VMI anomalies detected
Router# debug vmi multicast	Display VMI multicast packets
Router# debug vmi neighbor	Display VMI neighbor transaction debugging
Router# debug vmi packet	Display VMI packet trace
Router# debug vmi pppoe	Display VMI PPPoE packet/activity debug
Router# debug vmi registries	Display VMI registry calls

Virtual Template

Command or Action	Purpose
Router# debug vtemplate cloning	Virtual Template cloning information
Router# debug vtemplate error	Virtual Template errors
Router# debug vtemplate event	Virtual Template events
Router# debug vtemplate subinterface	Virtual Template subinterface command

Subscriber Service

Command or Action	Purpose
Router# debug sss errors	Subscriber Service Switch Manager errors
Router# debug ssss event	Subscriber Service Switch Manager events